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What is claimed is:

CLAIMS

1. An apparatus for chemically treating a surface of a workpiece comprising:
 - a supply of an input gas;
 - a supply of a precursor gas;
 - a supply of a purge gas;
 - a dispenser unit adapted to expose the surface of the workpiece to a direct flow of said precursor gas for a surface reactant formation, to provide a flow of said input over the workpiece, and to provide said purge gas between said precursor gas and said input gas to prevent mixing of said precursor and input gases, said dispenser unit further having a pair of evacuation ports for evacuating said purge gas; and
 - a source adapted to converge a beam of electromagnetic radiation in said flow of said input gas in close proximity to the surface of the workpiece, but spaced a finite distance therefrom, to dissociate said input gas into a high flux of generated reactive gas species that reacts with said surface reactant to chemically treat said surface of said workpiece.
2. The apparatus of claim 1, further comprising a flow of a transmission gas provided over said flow of said input gas, said transmission gas being substantially nonattenuating to preselected wavelengths of said electromagnetic radiation.
3. The apparatus of claim 1 further comprising a structure for causing relative motion between the surface of the workpiece, said dispenser unit, and said beam.

4. The apparatus of claim 1 further comprising a chamber for containing said workpiece and said gases during said processing, said chamber having a window transparent to said electromagnetic radiation.
5. The apparatus of claim 1 wherein said electromagnetic radiation is ultraviolet radiation.
6. The apparatus of claim 1 further comprising optics to focus said beam.
7. The apparatus of claim 6, wherein said optics further expand a cross sectional dimension of said beam such that said beam convergence into a wide scanning beam.
8. The apparatus of claim 1 wherein said finite distance is less than a few mean-free-path lengths of said generated reactive gas species.
9. The apparatus of claim 1 wherein said chamber further comprising a pair of exhaust pump for pumping on said evacuation ports and for exhausting gases from said chamber.
10. The apparatus of claim 1 wherein said dispenser unit includes a nozzle connected to said supply of input gas to provide a laminar flow across the surface of the workpiece.
11. The apparatus of claim 1 wherein said chamber further comprises heating and cooling components.

12. The apparatus of claim 5 wherein said chamber further includes a workpiece temperature sensor for measuring the temperature of the workpiece during processing; a pressure sensor for measuring the gas pressures in the chamber during processing, and a gas sensor for monitoring at least said generated reactive gas species.

13. The apparatus of claim 1 further comprising at least one mixing chamber.

14. The apparatus of claim 1 further comprising a controller adapted to control said chemical treatment according to a selected set of reaction parameters.

15. The apparatus of claim 1 further comprising a monitor adapted to monitor completion of said chemical treatment.

16. The apparatus of claim 1 further comprising a beam dump adapted to absorb reflected energy of said beam.

17. The apparatus of claim 1 wherein said dispenser unit is one of a plurality of dispenser unit and said beam is one of a plurality of beams.

18. An apparatus adapted for use in a reaction chamber for atomic layer deposition of a material onto a surface of a workpiece, comprising:

a first gas port adapted to provide a flow on an input gas over the surface of the workpiece to be dissociated by a radiation beam into a point of use generated reactive species;

a second gas port adapted to provide a direct flow of a precursor gas onto the surface of the workpiece which by chemisorption forms a first surface reactant;

a third gas port adapted to flow a purge gas to prevent mixing of said input and precursor gases; and,

a pair of evacuation ports adapted to evacuation at least said purge gas.

19. The apparatus of claim 18, further comprising a fourth gas port adapted to provide a transmission gas to the reaction chamber.